

REMARKS

Reconsideration of the above-identified application in view of the present amendment is respectfully requested.

The present amendment replaces the language "a secondary diol" in claims 20, 30, 32, 35, and 36 with the language "2,4-pentanediol". The amendment attempts to overcome the 35 U.S.C. §112, first paragraph, rejection on page 3, lines 8-12 of the Office Action. The Office Action states that:

"to recite a secondary alcohol with only one example in a chemical case, is to deprive the person of ordinary skill in the art of what is required to be effective, as to what m.w. alcohols are contemplated for this, whether both (or how many of for alcohols with plural hydroxyl groups) alcohol groups are contemplated as secondary or only one such group etc."

By reciting within claims 20, 30, 32, and 35 that the secondary diol is 2,4-pentanediol, this rejection is no longer relevant. Support for the limitation that the secondary diol is 2,4-pentanediol can be found in claims 31, 34, and 37 as well as the specification at page 13, line 10.

The present amendment also changes the term "being" in claims 20, 32, and 35 to "comprising". This change better defines the present invention and attempts to overcome the 35 U.S.C. §112 first paragraph and second paragraph rejections. Support for this change can found in original claim 1 and pages 7 and 11 of the specification.

Further, the present amendment deletes the term "block" from the specification and the abstract. The term "block" was

deleted from the specification and the abstract to make the specification consistent throughout.

Moreover, the present amendment cancels claims 31, 34, and 37 because these claims recite that the secondary diol is 2,4-pentanediol and the term 2,4 pentanediol is now recited in the independent claims.

Additionally, the present amendment presents arguments and supporting references that attempt to overcome the other 35 U.S.C. §112, first paragraph and second paragraph rejections.

Thus, the present amendment merely reduces the number of issues for appeal by overcoming the 35 U.S.C. §112 rejections and canceling rejected claims. Moreover, since the limitations of claims 31, 34, 37 were under consideration prior to the final Office Action a showing under 37 C.F.R. §1.116(b) is not believed to be needed.

The Applicants respectfully apologize for not including a copy of the documents referred to in the last response to the Office Action. The following documents are attached and will be referred to in discussing the rejections:

- 1) Holden et al., Thermoplastic Elastomers, 2nd ed., pages 1-5 and 15-27, Hanser/Gardner Publications, Inc. Cincinnati, 1996. (hereinafter, "Thermoplastic Elastomers").
- 2) Kirk-Othmer, Encyclopedia of Chemical Technology, 4th ed., Volume 9, pages 15-37, John Wiley and Sons, Inc. 1994. (hereinafter, "Encyclopedia of Chemical Technology").
- 3) Bhowmick et al., Handbook of Elastomers, New Developments and Technology, pages 375-376, Marcel Dekker, Inc. (hereinafter, "Handbook of Elastomers").

- 4) Billmeyer, Fred, Textbook of Polymer Science, 3rd ed., pages 4, 101, and 379, John Wiley and Sons Inc. 1984. (hereinafter, "Textbook of Polymer Science").
- 5) Whittington, Lloyd, Whittington's Dictionary of Plastics, pages 54 and 59-60, Technomic Publishing Co., Inc. 1968. (hereinafter, "Whittington's Dictionary of Plastics")
- 6) Lewis, Richard, Hawley's Condensed Chemical Dictionary, 12th ed., page 325, Van Nostrand Reinhold Company, 1993. (hereinafter, "Hawley's Condensed Chemical Dictionary")

The 35 U.S.C. §112 first paragraph and second paragraph rejections in the November 6, 2001 Office Action will first be discussed. A discussion of the 35 U.S.C. §103 rejection in the November 6, 2001 Office Action will then be presented.

I. 35 U.S.C. §112, first paragraph, rejections.

Claims 20-31 were rejected under 35 U.S.C. §112, first paragraph, as containing subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention.

The Office Action first states that the change to delete the term "block" is per se okay, but that it has not been carried out uniformly throughout; therefore, the specification not only remains incorrect but inconsistent throughout.

As noted above the abstract and the paragraph beginning at line 5, of page 3 have been amended to delete the term "block" from these paragraphs. Thus, the specification is now consistent and uniform throughout.

The Office Action also states that the basis for the added amounts as in claim 35, newly recited ingredients as in claim 21, and so on, has not been pointed out and that the Applicant is required to point out the basis for such newly claimed terms, or to cancel them.

The ingredients listed in claim 21 can be found in the specification on page 8, lines 6 and 7, which state that the preferred linear energetic polymer is glycidyl azide polymer and page 9, lines 3-13, which lists other linear energetic polymers that can be used in the present invention.

The amounts listed in claim 35 can be found in the specification on page 6, lines 23-24, which states that the preferred amount of inorganic salt oxidizer is in the range of about 65% to about 90% by weight based on the weight of the gas generating material, and page 13, lines 22-24, which states that a preferred weight % of thermoplastic elastomer is from about 5% to about 35% based on the weight of the gas generating material.

Additionally, the Office Action asserts: (i) that block copolymers must be derived from two different monomers, such as described in U.S. Patent No. 5,552,257 (ii) that a reaction of hydroxyl terminal groups with an isocyanate to produce a polyurethane is distinctly different than a reaction to form a block polymer; (iii) that referring to toluene diisocyanate as a block is entirely wrong and to refer to a diisocyanate residue of any simple diisocyanate as a block or segment, which may be thermoplastic, is wrong; and (iv) that

the idea of physically cross-linking is not correctly conveyed to one skilled in the art.

Claims 20-36 are described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention because the terms and language used to describe the invention are in conformance with those terms and language used by one skilled in the art.

The Encyclopedia of Chemical Technology on page 17, lines 18-20 states that:

"Five block copolymers are of commercial importance: poly(styrene-b-elastomer-b-styrene), thermoplastic polyurethanes, thermoplastic polyesters, thermoplastic polyamides, and polyetherimide-polysiloxane block copolymers."

The Encyclopedia of Chemical Technology also states, on page 24, lines 4-22, one method of forming a thermoplastic polyurethane block copolymer. In this method, a high molecular weight polyester or polyether with terminal hydroxyl groups is reacted with a diisocyanate and a secondary diol to form a "block copolymer" with an  $(A-B)_n$  structure.

It is further indicated in the reaction equation on page 24 of this document that the copolymerized polyester or polyether in this block copolymer forms the "soft rubbery segments" of the block copolymer, while the diisocyanate forms the "hard crystalline segments" of this block copolymer.

Thermoplastic Elastomers also teaches, on page 16, lines 41+ and page 17, lines 1-21, that TPUs (i.e., thermoplastic polyurethane elastomers) are multiblock polymers that include

one block that forms a hard segment and a second block that forms a soft segment. One type of block, the hard segment is formed by a chain extender, such as butane diol, and a diisocyanate, such as MDI. This hard segment is indicated in Fig. 2.1 on page 17 as comprising a urethane group. The other type of block is formed by the flexible polyether or polyester. (See page, 17, Fig. 2.1 and page 17, lines 3-6) It is the soft segments that give the elastomeric properties the thermoplastic elastomer (page 17, lines 14-15), "with the hard segments acting as multifunctional tie points that function both as physical cross-links and reinforcing fillers" (page 17, lines 17-21).

Thermoplastic Elastomers, on page 17, lines 17-21, also states that:

"the TPU network was described as 'virtually cross linked'. To obtain thermoplasticity, the average functionalities of the starting materials should be close to 2.00. That is, each prepolymer or monomer unit should have 2 terminal reactive groups. This ensures formation of the high molecular weight linear chains with no or only very few branch points."

Section 2.4.1 on page 25 of Thermoplastic Elastomers further adds that the hard segments which are comprised of the diisocyanate are expected to be crystalline and X-ray analysis of single crystals of these compounds revealed hydrogen bonds between neighboring urethane, which promote physical cross-linking.

Additionally, with regard to physical cross-linking in thermoplastic polyurethane elastomers, the Handbook of

Elastomers states, at page 375, lines 1-7, that to be useful in mechanical applications, the polymer chains of rubber-like elastomers (which are not thermoplastic) must be joined together in lateral fashion by covalent chemical cross-linking by a process known as vulcanization or curing.

"However, it was subsequently recognized that very high level, useful mechanical properties can be obtained by amorphous, low-Tg polyurethane elastomer systems that are essentially linearly structured, thermoplastic and therefore devoid of chemical cross-links. This phenomenon was attributed to tie points among the linear polyurethane chains that are reversible with heat or solvation, and the term 'virtual cross-link' (VC), i.e., 'cross-linked in effect but not in fact, was applied to such tie points... Published views bearing on the nature of virtual cross links in TPUs include hydrogen bonding among urethane-group hydrogen atoms and carbonyl groups."

Referring now to the language in the specification of the present application to which the Office Action states is misdescriptive, the present application on page 7, lines 14-16 states that:

"The polyurethane thermoplastic elastomer of the present invention comprises linear block copolymers that are physically cross-linked by hydrogen bonds."

This statement is neither misdescriptive nor incorrectly conveyed to one skilled in art.

First, it is well know in the art (as shown in Encyclopedia of Chemical Technology at page 17, lines 18-19; page 24, lines 4-22; and page 25, Table 4) that polyurethane thermoplastic elastomers can be formed from linear block copolymers.

It is also shown in the Handbook of Elastomers that the cross-linking of polyurethane thermoplastic elastomers by hydrogen bonds is known to one of ordinary skill in the art. Specifically, the Handbook of Elastomers states that

"Published views bearing on the nature of virtual cross links in TPUs include hydrogen bonding among urethane-group hydrogen atoms and carbonyl groups." (Page 376, lines 1-2).

This language in the patent application is further supported on page 17, lines 14-21 of Thermoplastic Elastomers, which is also note above.

Thus, the Applicants fail to see how this language is misdescriptive or incorrect.

Referring now to page 10, lines 3-11 of the present application recite:

"The isocyanate groups of the aromatic diisocyanate and the hydroxyl groups of the linear energetic polymers react, in urethane type reaction, to form a linear block copolymer with urethane linkages."

The Office Action states that this language is misdescriptive because the reaction to form a block copolymer is distinctly different than the reaction to form a polyurethane.

The Applicants respectfully disagree with this statement. Both the Encyclopedia of Chemical Technology and Thermoplastic Elastomers show that a urethane type reaction between the terminal hydroxyl groups of a polymer and a diisocyanate can form a block copolymer, which is a polyurethane. (See Encyclopedia of Chemical Technology page 24, liens 4-22, and Thermoplastic Elastomers sections 2.2 and 2.3, pages 17-24).



The only difference in the process of forming the block copolymers of the present invention and the process described in the references is that in the present invention the use of a chain extender, i.e., the secondary diol in the present invention, was found to be optional in the formation of the block copolymer.

The reaction product of the present invention, however, can still be considered a block copolymer even without the secondary diol. The reaction product of the energetic polymer and the diisocyanate of the present invention would include a first block. The first block would comprises the repeating unit that makes up the energetic polymer. The second block would comprise the two urethane groups that that are formed from the reaction of the diisocyanate. The Applicant understands that the urethane groups do not form a repeating segment unless the secondary diol is added. The Applicant however has found that the two urethane groups formed by the reaction of the aromatic diisocyanate formed a hard crystalline segment like the hard crystalline segment described on page 24 of the Encyclopedia of Chemical Technology. Therefore, the Applicant believed that to refer to the reaction product of the energetic polymer and the diisocyanate as a block copolymer was not misdescriptive because the reaction product was a copolymer (i.e., a polymer of two chemically distinct monomers-See attached definition in Whittington's Dictionary of Plastics) and also included a first block defined by the repeating unit of the energetic polymer and a second block defined by repeating (i.e., two)

urethane linkages. Regardless, the term block was eliminated from the specification in last Office Action.

The Office Action also rejects this language by stating that to refer to any isocyanate group as a block or segment is wrong.

The Applicant would first like to point out that nowhere in the specification is the isocyanate group referred to as a block or segment. Only the thermoplastic segments, which are provided by the urethane linkages, are referred as a segment. Referring to the urethane groups formed by the reaction of the diisocyanate as a block or segment is not misdescriptive. Fig. 2.1 on page 17 of Thermoplastic Elastomers refers to the hard segment as including the urethane group and diisocyanate. Section 2.2.2.1 beginning on page 21 of Thermoplastic Elastomers teaches specifically that diisocyanates can comprise the hard segment.

Referring now to page 10, lines 9-11 of the present application, these lines state that:

"The elastomeric segments are provided by the linear energetic polymer and the thermoplastic segment are provided by the urethane linkages."

With regard to this language the Office Action states that to refer to the isocyanate residue of any simple diisocyanate as a block or segment which may be "thermoplastic" is wrong and contrary to ordinary terms in the art.

The Applicant respectfully disagrees that to refer to the urethane linkages as a thermoplastic segment is wrong and contrary to ordinary terms in the art.

As previously noted, the Encyclopedia of Chemical Technology teaches at page 24 that the polymer used in forming the thermoplastic polyurethane elastomer forms an "elastomeric or soft segment in the final polymer". The Encyclopedia of Chemical Technology does not teach that isocyanates forms thermoplastic segments; however, the Encyclopedia of Chemical Technology does teach at page 21 that the hard segment determines the melting point of the thermoplastic polyurethane elastomer. Thermoplastic Elastomers further teaches on page 22 that the hard segment determine the glass transition temperature of the thermoplastic polyurethane elastomer. Thus, the prior art teaches that the soft segments are elastomeric segments and that the hard segment of the thermoplastic polyurethane elastomer provides the "thermoplastic" characteristics to the thermoplastic polyurethane. Therefore, given that Applicant is ordinarily afforded some latitude in describing the invention, to refer the hard segments of the thermoplastic polyurethane elastomer as the thermoplastic segments would not be wrong or contrary to ordinary terms of the art.

The Office Action further argues that,

"to recite a secondary alcohol with only one example in a chemical case, is to deprive the person of ordinary skill in the art of what is required to be effective, as to what m.w. alcohols are contemplated for this, whether both (or how many for alcohols with plural hydroxyl

groups) alcohol groups are contemplated as secondary or only one such group, etc."

As noted above, claims 20, 32, and 35 have been amended to recite that the secondary diol is 2,4-pentanediol. Therefore, claims 20, 32, and 35 are enabled.

The Office Action also states that the idea of physical cross-linking is not correctly conveyed to one of ordinary skill in the art, that it is not clear what the difference between what Applicant does and what Hawley's teaches occurs for all polyurethane elastomers, and that this basis is not sufficient for perverting ordinary art understood language.

First, it is noted that the difference between the present invention and the description in Hawley's is that the present invention relates to a thermoplastic polyurethane elastomer while Hawley's describes a polyurethane elastomer, which is not a thermoplastic. The distinction between a polyurethane elastomer and a thermoplastic polyurethane elastomer is noted in the Handbook of Elastomers.

Second, the description in the application of thermoplastic polyurethane elastomers does not pervert ordinary understood language. As noted above, it is well known those skilled in the art that thermoplastic polyurethane elastomers can be physically cross-linked by hydrogen bonds.

For example, Thermoplastic Elastomers teaches that hard segments of the thermoplastic polyurethane elastomer act as multifunctional tie points that function both as physical cross-links and reinforcing fillers. (page 17, lines 17-21). Section 2.4.1 on page 25 of Thermoplastic Elastomers further

adds that the hard segments which are comprised of the diisocyanate are expected to be crystalline and X-ray analysis of single crystals of these compounds revealed hydrogen bonds between neighboring urethane which promote physical cross-linking.

Additionally, the Handbook of Elastomers states that it was recognized that very high level, useful mechanical properties can be obtained by amorphous, low-Tg polyurethane elastomer systems that are essentially linearly structured, thermoplastic and therefore devoid of chemical cross-links. This phenomenon was attributed to tie points among the linear polyurethane chains that are reversible with heat or solvation. Published views bearing on the nature of the cross links in TPUs include hydrogen bonding among urethane-group hydrogen atoms and carbonyl groups.

This description is in agreement with the description on page 11, lines 6-11 of the present application, which states,

"Each of the urethane linkages within the copolymers so formed are capable of forming hydrogen bonds with an oxygen of the urethane linkage of another linear copolymer or with an oxygen of the linear energetic polymer of another linear energetic copolymer. By doing so, the linear copolymers physically cross-link and form the polyurethane thermoplastic elastomer."

Thus, idea of physical cross-linking of the thermoplastic polyurethane elastomers is properly conveyed to one skilled in the art.

The Office Action also states that:

"In discussing Ziegler in the reply, in contrast to the prior art teachings and in Hawley, it is clear that Applicant's attorney, at least, needs considerable education in polymer science, as there is essentially nothing that is argued which is either true, or even makes sense, to one of ordinary skill in the art."

The Applicant's attorney will attempt to restate his argument concerning the Zeigler reference with greater precision and clarity. This discussion will not be included here, but made below with respect to the 35 U.S.C. §103(a) reference.

**II. 35 U.S.C. §112, second paragraph, rejections**

Claims 20-37 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter, which Applicant regards as the invention.

The Office Action states that the language in the claims is incorrect, cannot be understood by the person of ordinary skill in the art, and fails to set forth the metes and bounds of the claimed invention.

First, the Office Action states it is not clear what is required by the "thermoplastic elastomer" language; particularly since the language does not specify any particular "linear energetic polymer", but merely recites what would be required for an ordinary polyurethane polymer.

The Applicant respectfully disagrees with the Office Action that the "thermoplastic elastomer" language is indefinite.

The "thermoplastic elastomer" language is not indefinite because the term is used consistently with prior art teachings and the term is clear to a person of ordinary skill in the art. The Textbook of Polymer Science states on page 379, second paragraph, that:

"The term *thermoplastic elastomers* is currently used to describe a wide variety of materials that have elastomeric properties at ambient temperatures, but process like thermoplastics, obviating the need for the vulcanization step to develop typical rubber like elasticity.

The thermoplastic elastomer of the present invention is consistent with this definition.

The use of the term "linear energetic polymer" is also consistent with prior art teachings. Energetic polymers are well known in the art as disclosed in U.S. Patent No. 5,741,998 (a copy of which is attached).

As to what is required by the thermoplastic elastomer of the present invention, it is required that the thermoplastic elastomer (i) be a thermoplastic elastomer, (ii) comprise a polyurethane, (iii) and that one of the ingredients used in forming the polyurethane be a linear energetic polymer.

As noted in Thermoplastic Elastomers and Handbook of Elastomers not all polyurethanes form elastomers and not all polyurethane elastomers are thermoplastics. Thus, the polyurethane of the present invention is distinguished from all polyurethanes in that (i) it forms a thermoplastic elastomer and (ii) it is formed using a linear energetic polymer. Therefore, what is required for the "thermoplastic

elastomer" language in claim 20 is clear to a person skilled in the art.

Second, the Office Action states that it is pointed out that "less than 2" functionality for the hydroxyl includes zero, the "energetic" polymer recitation does not require any hydroxyl groups, and a secondary diol may form a polyurethane.

The use of the language "two or less" in claim 20 is not indefinite. The language "two or less" is used to merely recite the maximum hydroxyl groups that the linear energetic polymer can have when reacting with the diisocyanate to form the thermoplastic elastomer of claim 20. Claim 20, when viewed in light of the specification, requires that the linear energetic polymer must have some hydroxyl functionality to react with the diisocyanate to form a polyurethane, but that this hydroxyl functionality is two or less. Moreover, it well settled that:

"The imposition of a maximum limit on the quantity of one of the reactants without specifying a minimum does not warrant distorting the overall meaning of the claim." In re Kirsch, 182 USPQ 286, 290 (CCPA 1974).

Third, the Office Action states that the claim language of "aromatic diisocyanate" and "a linear energetic polymer" at best only forms a polyurethane to one of ordinary skill in the art.

The Applicant respectfully disagrees the claim language "aromatic diisocyanate" and "linear energetic polymer" at best only forms a polyurethane. The definiteness of the language employed in the claim must be analyzed not in a vacuum, but in